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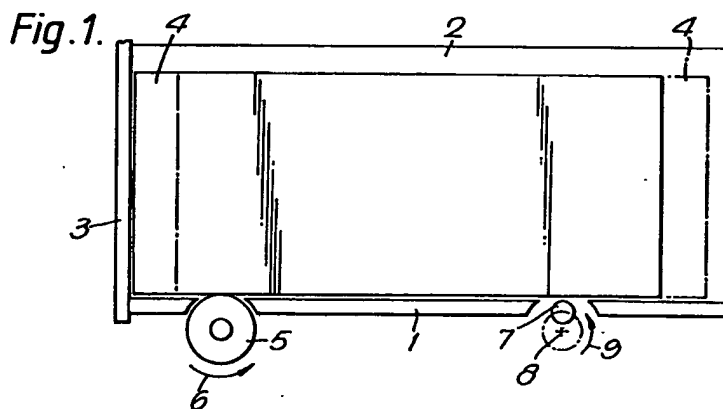
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(54) Apparatus for forming stacks of sheets

(57) In a sheet stacking apparatus, for example a sheet receiver at the output of a sorter, or the feed compartment receiving a stack of sheets at the input of a sorter, to form the sheets into a better stack, a roller (5) having a surface with a high co-efficient of friction is positioned transversely to the plane of the sheets in the stack so that a longitudinal portion of the roller periphery extends through a gap in the base (1) to contact the sheets along a line extending transversely across the lower edges of the sheets in the stack, the friction roller when rotated urging the sheets against an end support (3) of the sheet receiver. The lateral movement of the sheets by the friction roller may be facilitated by the provision of a cam wheel (7) with its axis parallel to the friction roller axis and contacting the lower edges of the sheets in the stack through a gap in the base, and air jets above the stack. The friction roller (5) may have a brush-like surface.



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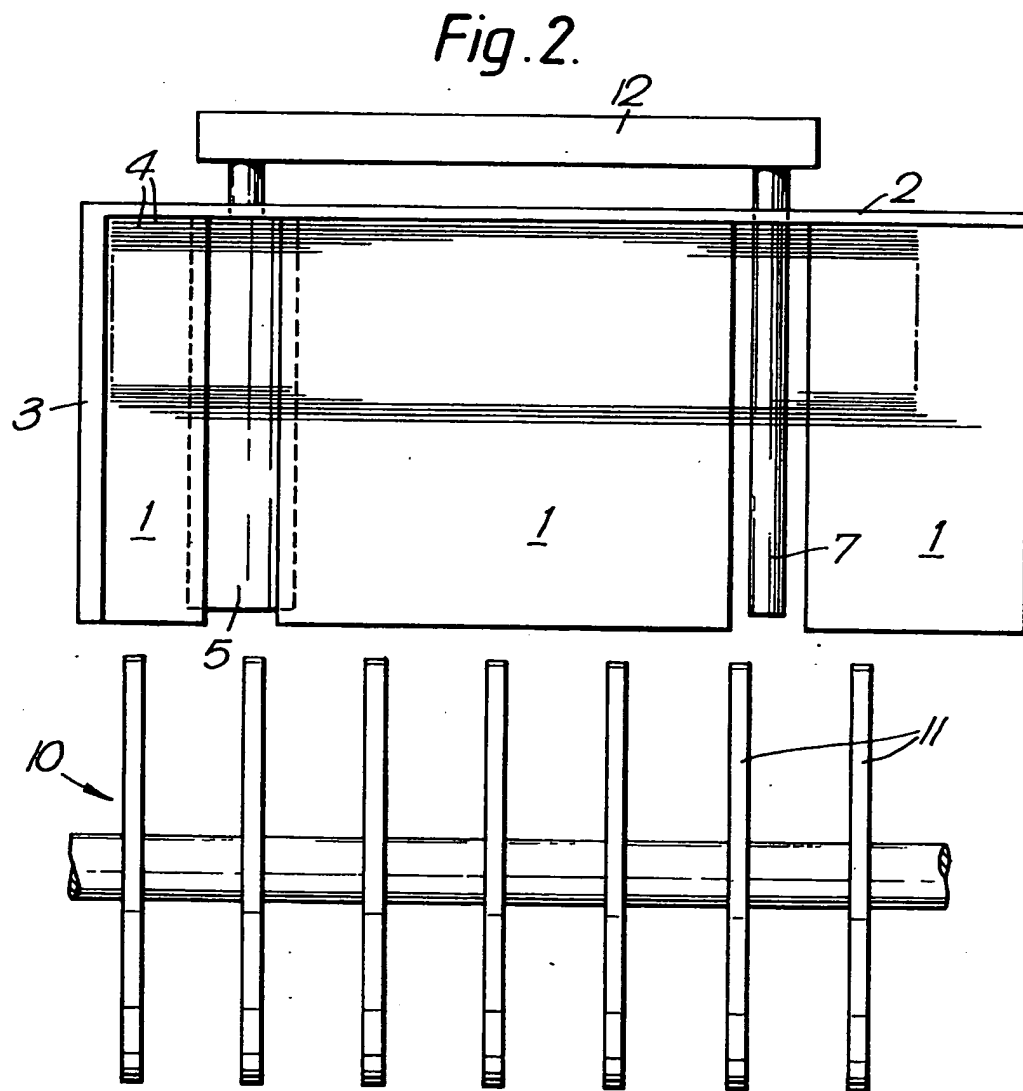
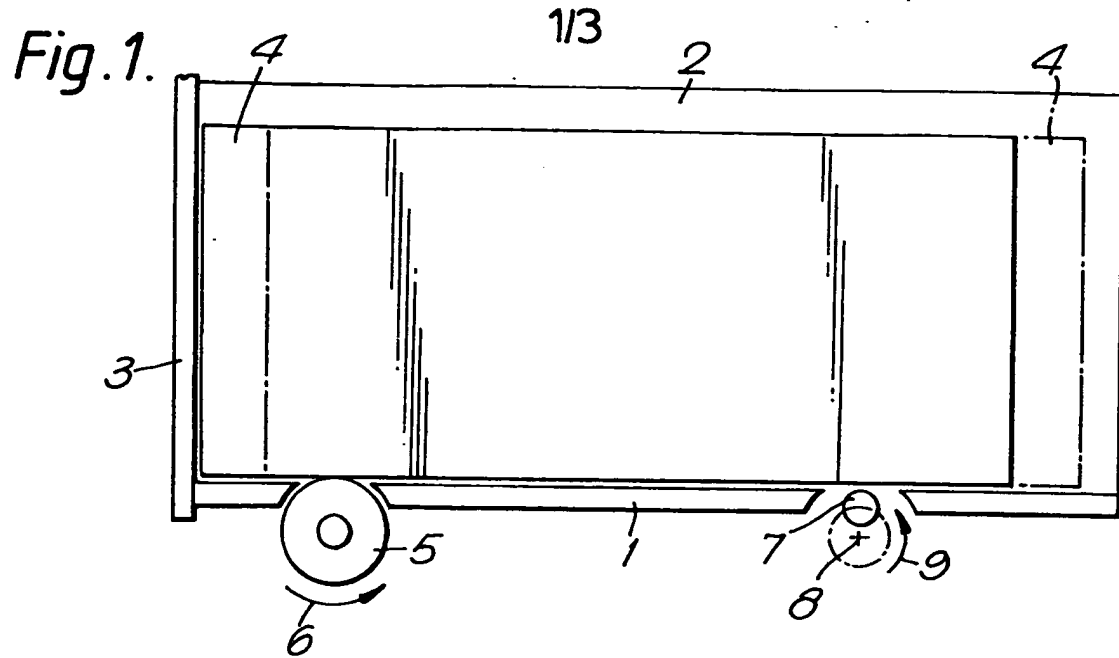


Fig. 3.

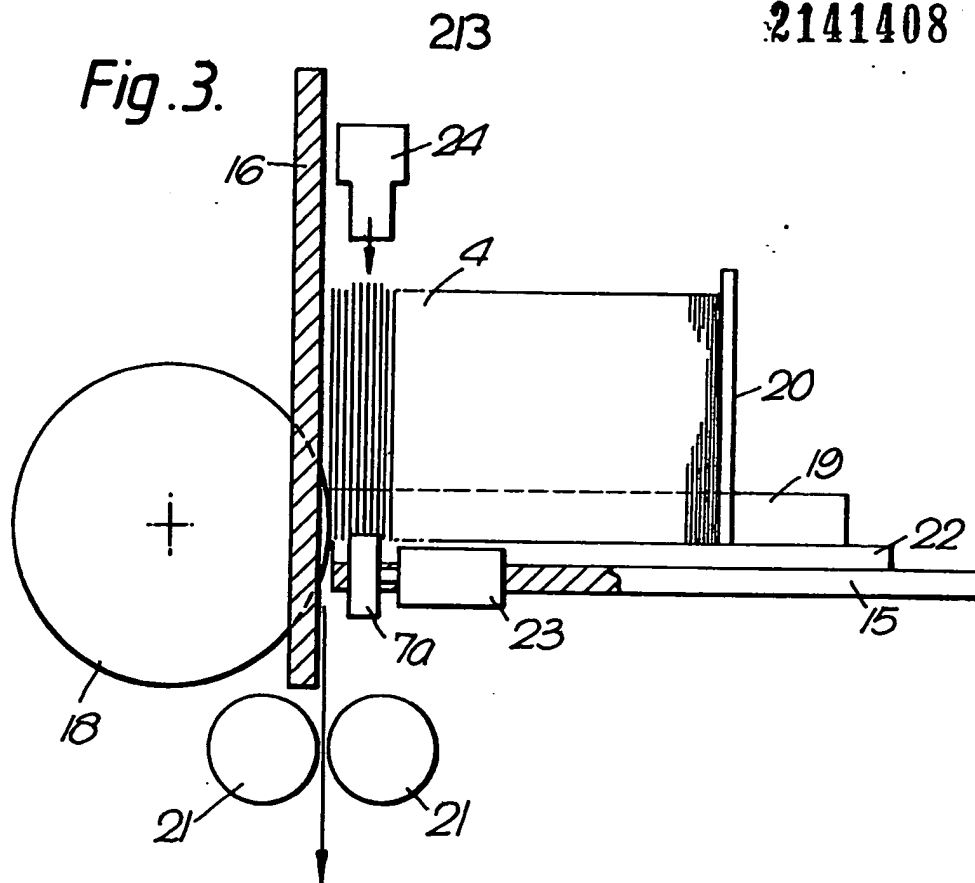


Fig. 4.

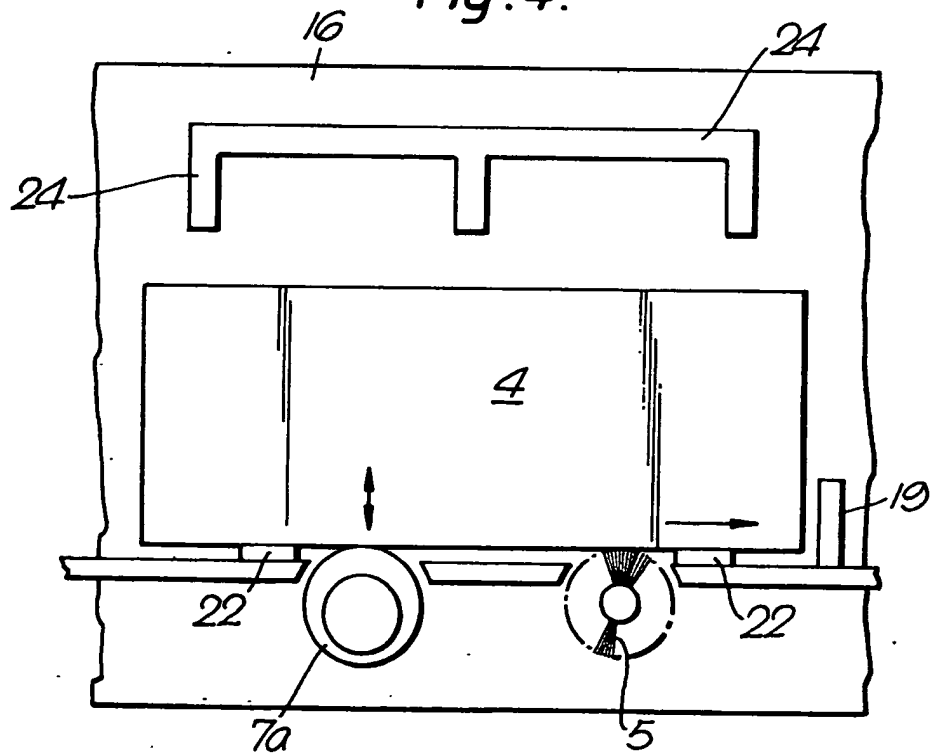
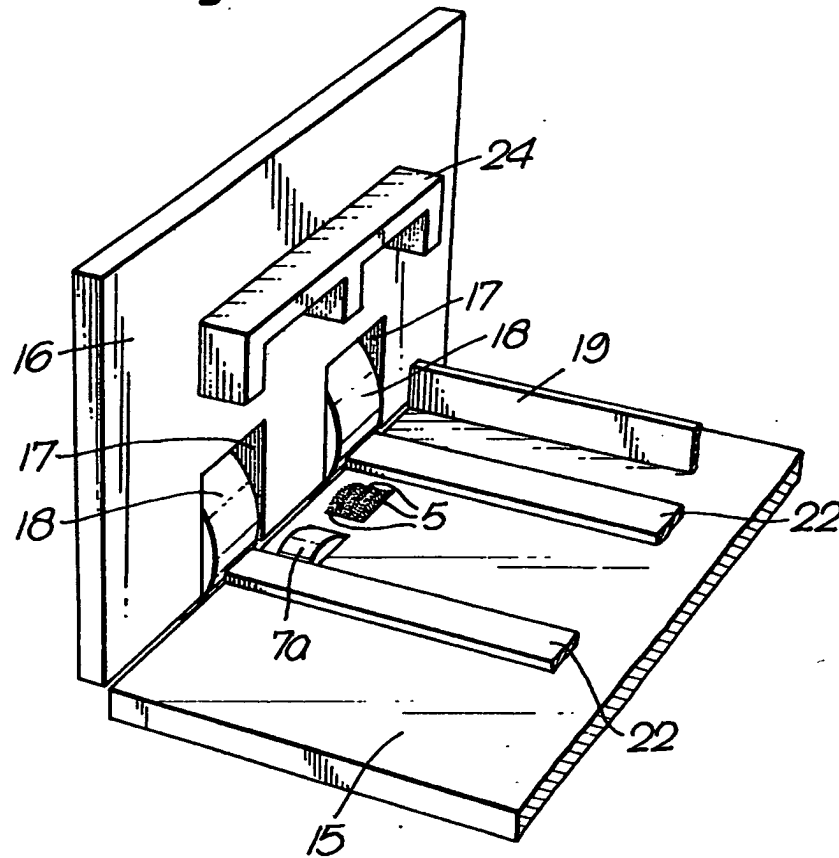
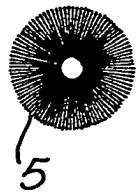
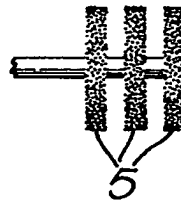


Fig. 5.*Fig. 6.**Fig. 7.*

SPECIFICATION

Apparatus for forming stacks of sheets

5 This invention relates to a receiver for a bundle of sheets; the sheets may have been placed in the receiver as a bundle or one by one.

For example, a bundle of sheets may have been placed in a sheet receiver at the input end of a banknote sorter; subsequently, the sheets are fed from the receiver one by one through sensing apparatus. Such sensing apparatus generally requires the banknotes to be fed at uniform intervals and to be advanced along the flow line in a given orientation, for example with the long edge of each banknote perpendicular to the direction of flow. Uniform spacing and correct orientation of the banknote are most likely to be achieved if prior to their feeding into the sensing apparatus, the notes in the receiver are in a neat stack located squarely in the receiver.

Alternatively, the receiver may be at the outlet end of such a banknote sensor, receiving banknotes one by one and forming a bundle which is subsequently to be banded. Again, it is desirable that the received banknotes are formed into a neat and compact stack.

According to the present invention, sheet stacking apparatus includes a sheet receiver comprising a base for supporting a stack of sheets on edge, a front support extending upwards from the base for supporting the front face of the stack, and an end support extending upwards from the base at right angles to the front support; a friction roller having an axis extending transversely to the planes of the sheets in the stack and positioned so that a longitudinal portion of the periphery of the roller extends through a gap in the base to contact the sheets along a line extending transversely across the lower edges of the sheets in the stack, and means for rotating the friction roller in a direction such as to urge the sheets against the end support of the sheet receiver.

Preferably, the apparatus further includes a cam rotating under the stack and acting on the stack of sheets through a gap in the base of the receiver for imparting a jogging motion to the sheets in the receiver to facilitate their movement by the friction roller.

We have found it advantageous, particularly for stacking worn sheets such as old banknotes, to use a friction roller having a brush-like surface.

In order that the invention may be better understood, examples of apparatus embodying the invention will be described with reference to the accompanying drawings, in which:-

55 *Figure 1* shows apparatus embodying the invention in front elevation;

Figure 2 shows the apparatus of *Figure 1* in plan, with means for delivering sheets singly to the sheet receiver;

60 *Figure 3, 4 and 5* show respectively a side elevation of an input hopper embodying the invention, a rear view of the hopper with parts removed, and a perspective view from behind and to one side of the hopper; and

65 *Figures 6 and 7* show an end view and a side

elevation respectively, of a friction brush used in the apparatus of *Figures 1* to *5*.

In *Figure 1*, the sheet receiver comprises a base 1, a front wall 2 and an end wall 3. Sheets 4 are supported on their long edges on the base 1, the full line indicating the final position of the sheets and the dotted line indicating a possible earlier position of a sheet.

Under the base 1 there is located a roller 5 having a surface of a high friction material or a brush surface. The axis of this roller extends at right angles to the plane of the front surface 2. When the roller is rotated in the direction indicated by the arrow 6, the sheets are urged toward the end plate 3.

Spaced from the roller 5 and also projecting through a gap in the base 1 is a cam member 7 which rotates about an axis 8 in the direction of the arrow 9, so that for a portion of its rotation it is above the plane of the upper surface of the base and for the remainder of its rotation it is below this plane. Such motion imparts a jogging action to the sheets 4 and this facilitates the movement of one sheet relative to others as a consequence of the rotation of the friction roller 5.

Thus, if a bundle of loose notes which are not accurately superimposed is placed in the sheet receiver, the combined action of the friction roller 5 and cam roller 7 would tend to urge all notes into a compact stack lying against the end face 3 and seated squarely in the receiver.

As indicated in *Figure 2*, a sheet receiver designed for the outlet end of a banknote sorting machine, for example, may be fed with notes one by one by a sheet delivery device 10 having for example a number of discs 11 formed with spiral slots. Such sheet delivery devices are well known. Also diagrammatically indicated in *Figure 2* is a common driving means 12 for the friction roller 5 and the cam roller 7.

If desired, the end stop 3 may be adjustably mounted on the base 1 to allow it to have different positions according to the length of the documents to be aligned and according to the tolerance in their lateral positions as they enter the aligning device. It would be appreciated that the cam roller 7 in the example described above has a secondary function of assisting the roller 5 to urge the sheets against the end stop 3. Typically, the friction roller may have a peripheral speed of 2 to 2.5 metres/second and the eccentric may rotate at a speed of 1400 to 1900 r.p.m.

115 *Figures 3, 4 and 5* illustrate the input end of a banknote sorter, a pack of notes 4 having being placed in a hopper to be fed one by one from the hopper to a note path. The hopper is defined by a feed table 15, a front plate 16 formed with apertures 17 through which vacuum stripper wheels 18 project, an adjustable end stop 19 and a spring-loaded backplate 20. The spring-loading arrangements for the plate 20 have been omitted for clarity. The pack of notes rests on "knives" 22, the ends of which are set relative to the vacuum stripper wheels 18 to define gaps of predetermined size through which the notes pass, the size being selected to reduce the possibility of feeding two notes at the same time. The vacuum stripper wheels 18 feed the front note from the pack past the knife edges into the nip of

pinch wheels 21 and so to the note flow path.

As in the earlier embodiment, a high friction roller 5 (in this case the roller having a brush surface) is positioned under the feed table but its periphery projects just above the plane of the knives 22 and when the brush wheel rotates in the direction indicated by the arrow in Figure 5, the notes in the pack are urged towards the end stop 19, which is adjustable to allow for notes of different lengths. As before, an eccentric wheel 7A also projects through a slot in the feed table to "upset" the initial batch of notes which are about to be fed out from the hopper. A motor 23 drives the eccentric wheel and brush.

The form of the brush is shown in end view in Figure 6 and in side view in Figure 7, from which it will be seen that it comprises three separate disc-like brushes.

Air hets 24 are arranged above the upper edges of the front section of notes to "riffle" the upper edges, that is to say to disturb them in the flow of air to facilitate the separation of the notes one from another by the suction wheels. These air jets provide the additional advantage that they make the front part of the pack very "fluid" and thus make it easier to move the notes sideways. In Figure 4, the front plate and note feed arrangements are not shown.

CLAIMS

1. Sheet stacking apparatus including a sheet receiver comprising a base for supporting a stack of sheets on edge, a front support extending upwards from the base for supporting the front face of the stack, and an end support extending upwards from the base at right-angles to the front support, a friction roller having an axis extending transversely to the planes of the sheets in the stack and positioned so that a longitudinal portion of the periphery of the roller extends through a gap in the base to contact the sheets along a line extending transversely across the lower edges of the sheets in the stack, and means for rotating the friction roller in a direction such as to urge the sheets against the end support of the sheet receiver,
2. Sheet stacking apparatus in accordance with claim 1, further including means for imparting a jogging motion to the sheets in the receiver to facilitate their movement by the friction roller.
3. Sheet stacking apparatus in accordance with claim 3, in which the means for jogging the sheets is a cam rotating under the stack and operating on the stack of sheets through a gap in the base of the receiver.
4. Sheet stacking apparatus in accordance with claim 1 or 2, in which the friction roller is a brush roller.
5. Sheet stacking apparatus in accordance with claim 1, 2, 3 or 4 further including means for delivering sheets one at a time to the sheet receiver.
6. Sheet stacking apparatus in accordance with claim 5, in which the sheet-delivery means includes a spiral-slot stacker wheel.
7. Sheet stacking apparatus in accordance with any one of claims 1 to 4, further including a spring-loaded rear plate for urging a stack of sheets,

placed in the sheet receiver, towards the front support, and a vacuum feed wheel on the side of the front support remote from the rear plate and extending through a slot in the front support for feeding the sheets one at a time out of the sheet receiver between the base and the front support and in a direction parallel to the front support.

8. Sheet stacking apparatus in accordance with claim 7, further comprising means directing an air jet at the edges of the sheets in the stack remote from the base plate for facilitating separation of the sheets by the vacuum feed wheel.

9. Sheet stacking apparatus, substantially as herein described with reference to the accompanying drawings.

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